



Worksheet 1 Logic Gates and truth tables **Answers**

Task 1

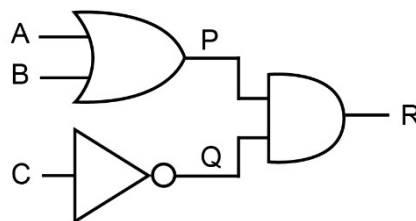
1. Write the following Boolean expressions using Boolean notation:

(a) (A AND B) OR NOT (D AND E) $(AB)(DE)$

(b) NOT A AND NOT (B OR C) $\neg A(BC)$

(c) (A AND B) OR (B AND (NOT C)) $(AB)(BC)$

2. (a) Complete the truth table for the following logic circuit.



(b)

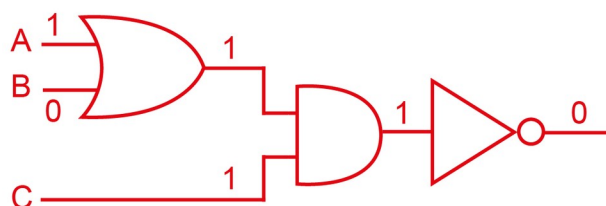
Input A	Input B	Input C	$P = A \vee B$	$Q = \neg C$	Output $R = P \wedge Q$
0	0	0	0	1	0
0	0	1	0	0	0
0	1	0	1	1	1
0	1	1	1	0	0
1	0	0	1	1	1
1	0	1	1	0	0
1	1	0	1	1	1
1	1	1	1	0	0

Write a Boolean expression to represent this circuit in terms of A, B and C, using Boolean notation.

$(A \vee B) \wedge \neg C$

3. Draw logic circuits to represent the following Boolean expressions, and in each case say what is the output if $A = 1$, $B = 0$ and $C = 1$, showing the output from each gate.

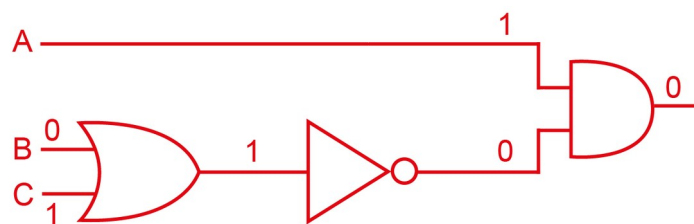
(a) $Q = \neg((A \vee B) \wedge C)$



Output: 0



(b) $Q = A \wedge (\neg(B \vee C))$



Output: 0

Task 2

4. Draw the truth tables for the following logic circuits:

(a) $A \underline{\vee} B$

Input A	Input B	Output Q
0	0	0
0	1	1
1	0	1
1	1	0

(b) $(A \wedge \neg B) \vee (\neg A \wedge B)$

Input A	Input B	$P = A \wedge \neg B$	$Q = \neg A \wedge B$	$Q = A \underline{\vee} B$
0	0	0	0	0
0	1	0	1	1
1	0	1	0	1
1	1	0	0	0

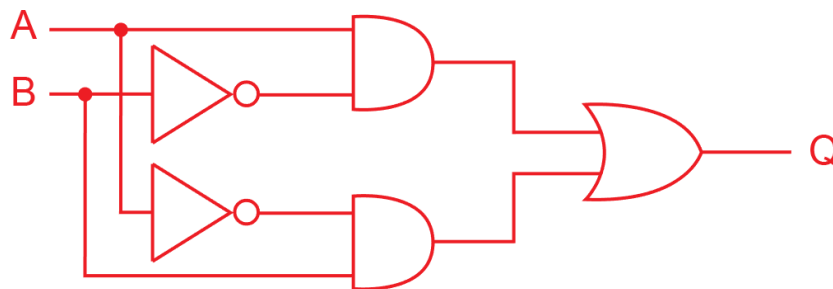
What do you notice about the output in each case?

The output of $A \underline{\vee} B$ is the same as the output of $(A \wedge \neg B) \vee (\neg A \wedge B)$.

This is the definition of the exclusive OR: A OR B but not both.



- (c) Draw the logic circuit for the expression: $Q = (A \wedge \neg B) \vee (\neg A \wedge B)$



5. (a) Write the following Boolean expression using Boolean notation:

(A XOR B) AND (NOT (C XOR D))

$(A \oplus B) \wedge \neg(C \oplus D)$

- (b) Draw the logic diagram using XOR, AND and OR gates, showing the output from each gate if the inputs for A, B, C and D are all 1.

